CHROMOSOME NUMBERS IN ALOE

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Since H. A. C. Müller's observations on the chromosomes of *Aloë striata* Haw. in 1912, chromosome counts have been determined for a large number of species of Aloe, Gasteria and Haworthia. There are 14 somatic chromosomes in almost all the species that have been studied in the first two genera, but a rather large amount of polyploidy is found in Haworthia, most of which is in the Coarctatae and Tessellatae sections. In the diploid plants, the haploid complement consists of four long and three short chromosomes, although the small ones are considerably larger than the chromosomes of many other genera of the flowering plants.

The writer (Riley, 1958, 1959a) has recently recorded the chromosome number of Aloe plants which he collected at de Wildt in the Transvaal or at or in the neighbourhood of the Great Fish River in the Cape, or which were given to him by Mr. A. Berg of Pretoria, Mr. H. Hall of Kirstenbosch or Dr. E. A. Schelpe, Curator of the Bolus Herbarium. The purpose of that study was to obtain further information on the frequency of polyploidy in the genus. Another paper dealing with chromosome numbers in Gasteria is also being published (Riley, 1959b).

During the course of the study on Aloe, a careful examination of the literature was made to compare the writer's results with those recorded by other investigators. No general tabulation of the chromosome numbers in Aloe has been published since Müller's (1945) thorough study and unfortunately his excellent paper is not widely known since it was published as a doctoral dissertation of the University of Pretoria rather than in an international journal and because it is written in Afrikaans. The writer is greatly indebted to Professor J. D. J. Hofmeyr of the University of Pretoria for calling it to his attention and to Professor F. G. Schweicherdt for the gift of his last spare copy. Since the publication of Müller's paper, papers have appeared by Afify (1945), Mendes (1950) and Snoad (1951a, 1951b) which list a large number of additional counts. Because of the general obscurity of Müller's list and because of the more recent chromosome determinations of the writer and others, it seems desirable to compile an up-to-date list which would include all the observations that have been published up to this time. Such a list will clearly reveal the frequency of polyploid or aneuploid chromosome numbers and will give some indication of the importance or lack of importance of differences in chromosome numbers in the evolution of the genus. While such a compilation should be of some value to all botanists interested in cytogenetic problems, it should be especially important for those of South Africa, where most of the species are found.

The list of chromosome numbers is to be found in Table 1 and includes the South African species and varieties arranged according to Reynolds's (1950) monograph, one plant of horticultural origin, a large number of putative hybrids, species found in countries other than the Union, species and varieties which are listed in neither Reynolds (1950) nor Jacobsen (1954) and which are probably of doubtful status, and 36 unidentified plants. This list includes all the chromosome counts that the writer was able to find in the literature. It probably lists all the important papers but may inadvertently omit some of the obscure ones. In the table are given the haploid or duploid number or both and the authorities for the various numbers reported.

Of the South African taxa as listed in Reynolds (1950), 80 species and nine varieties are diploid, one species is apparently a hexaploid and one species is reported as a diploid in one study and a hexaploid in another. This tabulation does not include plants regarded by Reynolds as synonyms. For example, *A. saponaria* Haw. was also listed as *A. latifolia* Haw. by Sato (1937, 1942) and *A. macracantha* by Johansen (1929) but has been counted only once. Also, the number of plants studied has been ignored and Riley's (1959a) 40 plants of *A. Davyana* are listed only once.

One horticultural form and 19 putative hybrids, including some published as species, such as *A. runcinata* Bgr. and *A. spuria* Bgr., are diploids. Of the plants growing outside the Union, 15 species and four varieties are diploid and only *A. ciliaris* f. *gigas* Res. is a polyploid. The 11 species not to be found in either Reynolds (1950) or Jacobsen (1954) are diploids. Thirty-one unidentified plants are diploids, one is a pentaploid and four are hexaploids.

Taking all the species, varieties, horticultural forms, hybrids and unidentified plants together, 95 per cent are diploids and only 5 per cent are polyploids. This percentage might be misleading, however, because of the unidentified plants. There is no evidence to indicate that each unidentified plant represents a different species and to include them might introduce a source of error especially, for example, if the four hexaploids all belong to the same species. If the unidentified plants are omitted, about 98 per cent of the identified types are diploids. Of the South African species, not including their varieties, only two out of 82, or about 2·5 per cent have polyploid individuals. Furthermore, it is of interest to consider the species that have been found with polyploid forms. They are *A. ciliaris* Haw., *A. ciliaris* f. *gigas* Res., *A. Tidmarshii* (Schonl.) Müller and *A. tenuifolia* Lam. The last is not found in either Reynolds nor Jacobsen and perhaps can be omitted. *A. Tidmarshii* has been considered to be a variety of *A. ciliaris*. Therefore, if *A. tenuifolia* is disregarded and if *A. Tidmarshii* is considered as merely a variety, then *A. ciliaris* becomes the only species on Aloe that possesses individuals with more than 14 chromosomes. At any rate, it can safely be stated that Aloe is a genus with a very low incidence of polyploidy and one in which differences in chromosome number have had little, if any, effect on evolution.

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TABLE 1.

The species of Aloe for which the chromosome numbers have been reported.

The species are arranged according to Reynolds (1950).

Species or variety	*n* no.	2*n* no.	Authorities
SOUTH AFRICAN SPECIES LISTED BY REYNOLDS (1950)			
Sec. 2 Graminialoe Reynolds:			
A. Saundersiae (Rey.) Reynolds as *Leptaloe Saundersiae* Rey.	7	14	Müller, 1945
A. albida (Stapf.) Reynolds as *Leptaloe albida* Stapf.	7	14	Müller, 1945
Sec. 3 Leptaloe Berger			
A. kniphofioides Baker as *A. Marshalli* Wood et Evans	7	14	Müller, 1945
A. chortolirioides Berger	7	14	Müller, 1945
A. nubigena Groenewald	7	14	Müller, 1945
A. verecunda Pole Evans	7	14	Müller, 1945
A. Vossii Reynolds	7	14	Müller, 1941, 1945
		14	Riley, 1959a
A. integra Reynolds	7	14	Müller, 1945
A. microcantha Haw.	7	14	Müller, 1941
A. Cooperi Baker	7		Kondo & Megata, 1943
	7	14	Müller, 1945
		14	Resende, 1937a; Riley, 1959a
A. Boylei Baker	7	14	Müller, 1945

Species or variety	*n* no.	2*n* no.	Authorities
Sec. 4 Eualoe Berger:			
A. longistyla Baker		14	Resende, 1937a
A. aristata Haw.		14	Resende, 1937a; Sato, 1937, 1942; Kondo & Megata, 1943; Riley, 1959a
as *A. aristata* Schult.		14	Snoad, 1951a
as *A. aristata* var. *leiophylla* Baker		14	Resende, 1937a
A. humilis (L.) Miller		14	Sato, 1937, 1942
as *A. humilis* Haw.		14	Resende, 1937a
A. humilis var. *echinata* (Willd.) Baker			
as *A. humilis* var. *equinata* Baker		14	Resende, 1937a
A. Krapohliana Marloth		14	Resende, 1937a
A. melanacantha Berger	7	14	Müller, 1945
		14	Resende, 1937a
A. brevifolia Miller		14	Resende, 1937a; Sato, 1937, 1942; Kondo & Megata, 1943; Snoad, 1951a
A. brevifolia var. *postgenita* Baker		14	Resende, 1937a
A. brevifolia var. *depressa* Baker		14	Resende, 1937a
A. pratensis Baker		14	Riley, 1959a
A. polyphylla Schonland		14	Riley, 1959a
A. glauca Miller		14	Resende, 1937a
A. lineata (Ait.) Haw.	7	14	Müller, 1941, 1945
A. lineata var. *Muirii* (Marloth) Reynolds			
as *A. Muirii* Marloth		14	Resende, 1937a
A. variegata L.	7	14	Kondo & Megata, 1943
		14	Resende, 1937a; Sato, 1937, 1942; Snoad, 1951a
as *A. ausana* Dinter		14	Resende, 1937a
A. saponaria (Ait.) Haw.		14	Taylor, 1925a, 1925b; Resende, 1937a; Sato, 1937, 1942; Snoad, 1951a
as *A. latifolia* Haw.		14	Sato, 1937, 1942
as *A. macracantha* Baker	7	14	Johansen, 1929
as *A. macrantha*		14	Suto, 1936, attributed to Johansen
A. saponaria (var. ?)		14	Resende, 1937a, 1937b
A. Davyana Schonland		14	Kondo & Megata, 1943; Riley, 1959a
A. Davyana var. *subolifera* Groenewald	7	14	Müller, 1945
A. Verdoorniae Reynolds		14	Riley, 1959a
A. mudenensis Reynolds		14	Riley, 1959a
A. Greenii Baker	7	14	Müller, 1945
		14	Resende, 1937a; Snoad, 1951a
A. Dyeri Schonland	7	14	Müller, 1945
A. pruinosa Reynolds	7	14	Müller, 1941, 1945
A. Fosteri Pillans	7	14	Müller, 1945
		14	Riley, 1959a
A. Vogtsii Reynolds	7	14	Müller, 1945
A. Lettyae Reynolds	7	14	Müller, 1941, 1945
A. longibracteata Pole Evans		14	Resende, 1937a, 1937b; Riley, 1959a

Species or variety	*n* no.	2*n* no.	Authorities
A. barbertoniae Pole Evans			
as *A. Barbertonia* Pole Evans		14	Resende, 1937a
A. deWettii Reynolds	7	14	Müller, 1945
A. transvaalensis O. Kuntze			
as *A. laxissima* Reynolds	7	14	Müller, 1941, 1945
A. parvibracteata Schonland		14	Riley, 1959a
as *A. pongoloensis*		14	Resende, 1937a
A. Simii Pole Evans	7	14	Müller, 1945
A. zebrina Baker	7		Fernandes, 1931; Kondo & Megata, 1943
		14	Fernandes, 1930; Resende, 1937a
A. grandidentata Salm Dyck	7		Marshak, 1934
		14	Resende, 1937a
A. striata Haw.	7		Sax (in Marshak, 1934); Kondo & Megata, 1943; Müller, 1945
		14	Resende, 1937a, 1937b; Müller, 1945; Riley, 1959a
as *A. Hanburyana* Naud. (*A. striata* Haw.)		14	Müller, 1912
A. karasbergensis Pillans		14	Riley, 1959a
A. suprafoliata Pole Evans	7	14	Müller, 1941, 1945
A. pretoriensis Pole Evans	7	14	Müller, 1941, 1945
		14	Resende, 1937a
A. claviflora Burchell		14	Riley, 1959a
as *A. Schlechteri* Schonland		14	Resende, 1937a., 1937b
A. hereroensis Engl.	7	14	Müller, 1941, 1945
		14	Resende, 1937a; Riley, 1959a
A. rubrolutea Schinz	7	14	Müller, 1941, 1945
		14	Resende, 1937a; Riley, 1959a
A. cryptopoda Baker	7	14	Müller, 1945
		14	Riley, 1959a
as *A. Pienaarii* Pole Evans	7	14	Müller, 1945
		14	Resende, 1937a
A. Wickensii Pole Evans	7	14	Müller, 1941, 1945
		14	Riley, 1959a
A. Wickensii var. *lutea* Reynolds	7	14	Müller, 1941, 1945
A. Chabaudii Schonland	7	14	Müller, 1945
		14	Riley, 1959a
A. tenuior Haw.	7	14	Müller, 1945
		14	Resende, 1937a; Snoad, 1951a; Riley, 1959a
A. tenuior var. *rubriflora* Reynolds	7	14	Müller, 1941, 1945
A. tenuior var. *decidua* Reynolds	7	14	Müller, 1945
A. ciliaris Haw.	21		Müller, 1941
	21	42	Müller, 1945
	25		Gioelli, 1930
		42	Resende, 1937a; Snoad, 1951a; Riley, 1959a
		45	Ferguson, 1926
A. Tidmarshii (Schonl.) Müller	7	14	Müller, 1945
as *A. ciliaris* var. *tidmarshii* Schonl.		42	Snoad, 1951a
A. gracilis Haw.			

Species or variety	*n* no.	2*n* no.	Authorities
as *A. laxiflora* N. E. Brown	7	14	Müller, 1941, 1945
		14	Resende, 1937a
A. commixta Berger		14	Snoad, 1951a
A. striatula Haw.	7		Fernandes, 1931; Müller, 1941, 1945
		14	Fernandes, 1930; Resende, 1937a; Müller, 1941, 1945; Snoad, 1951a; Riley, 1959a
A. *Pearsonii* Schonland		14	Resende, 1937a
A. mitriformis Miller		14	Riley, 1959a
as *A. mitriformis* Haw.		14	Resende, 1937a, 1939
as *A. parvispina* Schonland		14	Resende, 1937a
as *A. mitriformis* var. *Commelinii* Baker		14	Resende, 1937a, 1941
as *A. mitriformis* var. *spinulosa* Baker		14	Resende, 1937a
as *A. mitriformis* var. *flavispina* Baker		14	Resende, 1937a
A. Comptonii Reynolds		14	Riley, 1959a
A. comosa Marloth et Berger		14	Riley, 1959a
A. succotrina Lam.		14	Resende, 1937a; Riley, 1959a
as *A. purpurascena* Haw.		14	Resende, 1937a
A. microstigma Salm Dyck		14	Resende, 1937a; Riley, 1959a
as *A. Juttae* Dinter		14	Resende, 1937a
as *A. Brunthaleri*	7		Propach, 1934
as *A. Brunthalerii*		14	Resende, 1937a
A. framesii L. Bolus		14	Riley, 1959a
A. arborescens Miller	7		Gioelli, 1930; Kondo & Megata, 1943; Müller, 1941, 1945
		14	Taylor, 1925a; Ferguson, 1926; Gioelli, 1930; Resende, 1937a; Müller, 1941, 1941, 1945; Snoad, 1951a
as *A. arborescens* var. *natalensis* Berger	7	14	Ferguson, 1926
		14	Resende, 1937a
A. pluridens Haw.	7	14	Ferguson, 1926; Müller, 1945
		14	Resende, 1937a
A. mutabilis Pillans	7	14	Müller, 1941, 1945
A. speciosa Baker		14	Resende, 1937a; Sato, 1937, 1942; Riley, 1959a
Sec. 5 Anguialoe Reynolds:			
A. castanea Schonland	7	14	Müller, 1945
Sec. 6 Pachydendron Haw.:			
A. globuligemma Pole Evans	7	14	Müller, 1941, 1945
		14	Resende, 1937a, 1937b; Riley, 1959a

Species or variety	*n* no.	2*n* no.	Authorities
A. aculeata Pole Evans	7	14	Müller, 1941, 1945
		14	Riley, 1959a
A. petricola Pole Evans		14	Riley, 1959a
A. Reitzii Reynolds	7	14	Müller, 1941, 1945
		14	Riley, 1959a
A. Gerstneri Reynolds	7	14	Müller, 1945
A. ferox Miller	7		Fernandes, 1931; Kondo & Megata, 1943
		14	Fernandes, 1930; Resende, 1937a; Sato, 1937, 1942; Riley, 1959a
as *A. supralaevis* Haw.		14	Resende, 1937a
A. angelica Pole Evans		14	Riley, 1959a
A. rupestris Baker	7		Riley, 1959a
A. Thraskii Baker	7	14	Müller, 1941, 1945
as *A. Thraskii* de Wildeman		14	Resende, 1937a
A. Marlothii Berger		14	Resende, 1937a; Riley, 1959a
Sec. 7 Dracoaloe Berger:			
A. ramosissima Pillans		14	Riley, 1959a
A. dichotoma Masson		14	Riley, 1959a
as *A. dichotoma* L. E.		14	Resende, 1937a
Sec. 8 Aloidendron Berger:			
A. Bainesii Th. Dyer		14	Resende, 1937a
Sec. 10 Kumara Medic:			
A. plicatilis (L.) Miller	7		Fernandes, 1931
		14	Fernandes, 1930; Resende, 1937a; Snoad, 1951a; Riley, 1959a
HORTICULTURAL FORMS			
A. arborescens var. *frutescens* Link		14	Resende, 1937a
PUTATIVE HYBRIDS			
A. arborescens Mill. × *A. chortilirioides* Bgr.	7	14	Müller, 1945
A. arborescens × *A. ferox* (= *A. caesia* S. D.)		14	Gioelli, 1930; Resende, 1937a
A. arborescens × *A. ferox* (= *A. Salmdyckiana* Schult.)	7		Fernandes, 1931
		14	Fernandes, 1930; Resende, 1937a
A. bortiana		14	Sato, 1937, 1942
A. ferox var. *Galpini* Ret. × *A. microstigma* S. D.	7	14	Müller, 1945
A. globuligemma × *A. castanea*	7	14	Müller, 1945
A. humilis × *A. spinosissima* Hort.		14	Fernandes, 1930, 1931; Resende, 1937a
A. × *Paxii* Terraciano f.	7		Fernandes, 1931
		14	Fernandes, 1930; Sato, 1937, 1942
A. runcinata Berger		14	Resende, 1937a

Species or variety	*n* no.	2*n* no.	Authorities
as *A. obscura* Berger (non Miller)		14	Resende, 1937a
A. saponaria × *A. macracantha* ?		14	Mendes, 1950
A. × *Schimperi* Todaro		14	Resende, 1937a; Snoad, 1951a
	7	14	Afify, 1945
as *A. schumperi*		14	Sato, 1937, 1942
A. speciosa × *A. striata*		14	Resende, 1937a
A. speciosa × *A. supralaevis*		14	Resende, 1937a
A. × *spinosissima* Hort.) (= *A. humilis* var. *echinata* × *A. arborescens* var. *pachythyrsa*)		14	Fernandes, 1930; Resende, 1937a; Snoad, 1951a
A. spuria Berger		14	Sato, 1942
A. striata × *A. saponaria*		14	Resende, 1941
A. striata × *A. Schimperi*		14	Resende, 1937a
A. striata × *A.* sp. (?)	7		Kondo & Megata, 1943
A. Todari var. *praecox* Borzi	7		Gioelli, 1930
as *A. Zodari* var. *praecox*	7		Suto, 1936, attributed to Gioelli (1930)
A. × *Winteri* Berger	7		Fernandes, 1931
		14	Fernandes, 1930

SPECIES FOUND IN COUNTRIES OTHER THAN SOUTH AFRICA

A. abyssinica Lam. (Eritrea)	7		Ferguson, 1926
A. andringitensis H. Perrier (Madagascar)		14	Resende, 1937a
A. Beuttnerii Berger (Togo)		14	Resende, 1937a
A. bulbillifera H. Perrier (Madagascar)		14	Resende, 1937a
A. Cameronii Hemsl. (Uganda ?)	7		Ferguson, 1926
	7	14	Müller, 1945
A. capitata var. *typica* (Madagascar)		14	Sato, 1937, 1942
A. ciliaris f. *gigas* Resende (= *A. gigas* Res.) (Coimbra Bot. Garden)		35	Resende, 1938
A. concinna Baker (Zanzibar)		14	Resende, 1937a
A. confusa Engler (Tanganyika)	7	14	Müller, 1945
A. eru Berger (Eritrea)		14	Resende, 1937a
A. lateritis Engler (Tanganyika)		14	Resende, 1937a
A. litoralis (Angola)	7	14	Koshy, 1937
A. macrocarpa (Eritrea)		14	Sato, 1937, 1942
A. madecassa H. Perrier (Madagascar)		14	Resende, 1937a
A. percrassa Todaro (Eritrea)	7		Fernandes, 1931
		14	Fernandes, 1930; Resende, 1937a
A. Steudneri Schweinfurth (Eritrea, Abyssinia)		14	Resende, 1937a
A. vera L. (Madeira, Canary Is., Cape Verde, India)	7		Marshak, 1934; Joshi, 1937
		14	Sutaria, 1932
as *A. vera* Miller		14	Resende, 1937a
A. vera var. *chinensis* Bak. (= *A. chinensis* Bak. ?) (East Indies)		14	Resende, 1937a
A. vera var. *chinensis* Haw. (East Indies)	7		Kondo & Megata, 1943

SPECIES AND VARIETIES NOT IN REYNOLDS (1950), NOT JACOBSEN (1954)

A. bergeriana Dinter		14	Resende, 1937a
A. coccinea ?		14	Snoad, 1951a
A. cristata	7		Ferguson, 1926

Species or variety	*n* no.	2*n* no.	Authorities
A. cristula (= *A. cristata* ?)	7		Suto, 1936, attributed to Ferguson, 1926
A. grandis	7		Ferguson, 1926
A. longifolia Haw.		14	Snoad, 1951a
A. mitriformis var. *typica*		14	Resende, 1937a
A. Strausii Berger	7		Fernandes, 1931
		14	Fernandes, 1930
A. stricta (misspelling for *A. striata* ?) . .		14	Sato, 1937, 1942
A. tenuifolia Lam.		42	Snoad, 1951a
A. Varvarii	7	14	Gioelli, 1930
UNIDENTIFIED PLANTS			
A. sp. (J. Brown, Southall)		14	Snoad, 1951a
A. sp. (5 plants)		14	Resende, 1937a
A. sp. (23 plants)		14	Snoad, 1951b
A. sp. (1 plant)	7	14	Mendes, 1950
A. sp. (1 plant)		14	Riley, 1959a
A. sp. (1 plant)		35	Snoad, 1951b
A. sp. (4 plants)		42	Snoad, 1951b